Circular Design Project – Open Knowledge Co-creation for Circular Economy Education

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ABSTRACT

Design has a key role to play in developing innovative solutions to current local and global challenges – approaches that must consider the needs of end users and integrate sustainability criteria in processes and strategies for creating products and services.

The Circular Design – Learning for Innovative Design for Sustainability (L4IDS) project is a three years Erasmus+ Knowledge Alliance financed project, within the social business and the educational innovation field. The project's goal is to support the development of skills necessary to promote sustainable production and consumption of products and services in Europe. This is achieved through a knowledge co-creation process and a collaborative action research framework, which led to the development of training materials in order to teach and train students, academics and enterprise staff in Innovative Design for Sustainability (IDfS) strategies. The project is aligned with European Circular Economy policies and contributes to the realization of a more sustainable society.

The project has four objectives: (1) to increase and improve the learning strategies of Design for Sustainability; (2) to gather and cluster open educational resources and training courses for industry staff and academics in Innovative Design for Sustainability; (3) to train up innovative and entrepreneurial students designers who are capable of dealing with a transition towards Design for Sustainability as a mainstream design approach, and (4) to establish a basis for a permanent and active European Network of Design for Sustainability.

The project was formed by 12 partners who are organised around four country hubs in Ireland, The Netherlands, Catalonia and Sweden. Each country hub consists of one university with education and research in Sustainable Design, one design company with expertise in sustainable design and one national design association.

The researchers and professionals involved with the project demonstrate how an interdisciplinary co-design approach tackling wicked design problems can develop viable sustainable and product service systems in partnership with SMEs and students. Following this line of thought, this paper will introduce an internship programme that builds a collaboration among institutions and businesses, while enabling novice designers to experience real-life challenges and developing sustainable design solutions that can transform business practices to address issues of sustainability. Therefore, a total of 11 projects were performed by 48 interns and 16 industry partners. Addressing environmental problems 7 of them were focused on sustainable product solutions and 4 of them offered solutions to enhance the implementation of circular processes in the urban environment.

As a reinforcement for the project's mission, it was recognized as a best practice under the umbrella of the World Environment Day, promoted by the Barcelona City Council.

KEYWORDS

Design for Sustainability, Circular Economy, Open Educational Resources, Knowledge Co-creation Process, Interdisciplinary Co-design.

SESSION

LEARN – new educational models / applied research / making / raise awareness

1. INTRODUCTION

The Circular Design - Learning for Innovative Design for Sustainability (L4IDS) project is a three years (2016-2019) Erasmus + Knowledge Alliance financed project.

The project leads an increase and improvement of the learning strategies of Design for Sustainability, and identifies opportunities for sustainably designed products and services as well as business opportunities in both higher education institutions and industries in the four partner countries. This is achieved through a knowledge co-creation process and a collaborative action research framework, which led to the development of training materials in order to teach and train students, academics and enterprise staff in Innovative Design for Sustainability (IDfS) strategies.

Common goals among Circular Design partners are to train up innovative and entrepreneurial designers and non-designers capable of dealing with a transition towards Design for Sustainability as a mainstream design approach, as well as to promote cooperation and mobility with the EU's partner countries.

The researchers involved with the project demonstrate how an interdisciplinary co-design approach to tackling 'wicked design problems' can develop viable sustainable product and product service systems in partnership with SMEs and students.

The project is aligned with European Circular Economy policies and contributes to the realization of a more sustainable society. The following project outcomes are presented:

- The Best Practice Publication, shows the whole design process, materials, challenges, problems and other key issues of 10 Circular Design case studies within sectors like technology, furniture, clothing, lighting or packaging, to demonstrate that circular design strategies can be applied to improve the efficiency of almost every system.
- The Open Educational Resources database (http://circulardesigneurope.eu/oer/) where resources in Circular design are clustered in three taxonomies: Categories (First-timers; Practitioners), Level (Beginner; Intermediate; Advanced) and Tags (calculator; report; …).
- Mobility scheme, four international one semester internships were developed for undergraduate design students. Four universities were involved in the project with the participation of 16 companies and 48 students.
- The Circular Design Digital Fabrication Lab Handbook to introduce students, partner, companies and academics to the open-source, participatory, experimental and design & build approach within digital fabrication labs.
- The development of three Training Co-creation Workshops and a Professional Development Course in Circular Design that will be soon available as an open source tool.

2. CONCEPTUAL FRAMEWORK

The concept of sustainable design as a specialism within design, business and manufacturing is not a new one. Writers and educators such as Victor Papanek [1] and Buckminster Fuller [2] were advocating a change in the way we taught students how to design and look at the world in which they live. In parallel with this, many other experts [3] [4] were highlighting the difficulties being caused by industrialization and global trade in the natural environment. Issues such as the dramatic impact of the global population on ecosystems; the strains on the global and local economic systems and the challenges meted by social inequity were starting to be raised by scientists, economists and even designers as early as the 1960s. These are now finally accepted as real problems for today's students and professionals and for the world as a whole. They now provide clear opportunity both to graduates and to businesses as fields in which they can provide and develop expertise with a view to mitigating past and future problems.

Several studies have compared efforts at different institutions with regard to the inclusion of sustainability within design (engineering) curricula. Based on experiences at three European undergraduate programs, Dewulf [5] explores how to truly integrate sustainability in a program beyond a single module. Also studying multiple programs, de Eyto [6] makes a first attempt at exploring the impact of such integrated teaching on the professional careers of designers and engineers. Finally, again based on experiences from multiple institutions, Wever [7] gathers early experiences from educators in teaching a circular economy perspective to designers, exploring how the required skill set is different from regular design as well as design for sustainability.

There is growing evidence that the design business has a keen appetite for graduates who have a sustainable literacy as an integral part of their undergraduate skill set [8]. Unfortunately, many educators are at odds with each other as to how to effectively implement this subject. Opinions diverge from arguments on stand-alone courses [9], to others for embedding sustainable development inherently into all third level programs [10]; while the most radical re-builds the entire curriculum with sustainable development underpinning it [11]. Besides education also businesses are starting to address the lack of capacity in sustainable design practice [12].

The UK Design Council's Scoping Report from 2005 [13], it undertook a broad brush assessment of existing Sustainable Design Education in the UK and compared it to what they term Mainstream Design Education. They concluded that many of the differences between Mainstream Product Design Education (MPDE) and Sustainable Product Design Education (SPDE) mirror the differences between Mainstream and Sustainable Product Designers. The report states that in general, MPDE still focuses primarily on equipping students for positions within mainstream product design which sees the mainstream marketplace as providing the main employment opportunities. [13]

Research conducted by de Eyto, McMahon et al [14] concluded that there were various limitations to the nature of DfS within higher education in most EU countries. Specifically, the fact that while DfS was topical and of interest to undergraduate and master's students, the teaching faculty in many of the EU design HEIs (Higher Education Institutes) were limited in their capacity to deliver high quality case studies and DfS expertise.

A variety of new programs and initiatives have developed since the late 2000s which have sought to address this imbalance in design education. (Under)graduate Design Programs at TU Delft (NL) [15] [16], Loughborough University (UK), University of Limerick, Institute of Technology Carlow (IRL) and others developed specialist modules in DfS as a means to integrate it within the standard curricula. In addition, many other engineering and industrial ecology programs throughout the EU have included DfS and Circular Economy (CE) as a specific area of study within their programs.

3. METHODOLOGY

Integrating principles of sustainability, and its design-related competencies, throughout design education is a holistic approach that can result in deep learning over an extended period of time. Such integration, however, should involve differing perspectives of academic staff in a holistic manner, while at the same time ensuring that core competencies related to design education are still being conveyed to future designers [17]. In order to ensure that issues of sustainability are addressed properly and not just as an additional consideration in design courses, a more hybrid approach should be developed and adopted in education [17] [18]. In addition, continued professional development of academics is also necessary to keep up with ongoing changes and advancements around the topic of sustainability [17]. Collaboration and knowledge exchange among different institutions to build educational capacity [17] [19] and between universities and industry to transform business practices [20] is crucial. Following this line of thought, this paper will introduce an internship programme that builds such a collaboration among institutions and businesses, while enabling novice designers to experience this complex relationship first hand in developing sustainable design solutions that can transform business practices.

As part of the Learning for Innovative Design for Sustainability (L4IDS) Erasmus+ Knowledge Alliance project, four European institutions with design departments [Universitat Politècnica de Catalunya (UPC) in Spain, University of Limerick (UL) in Ireland, NHL University of Applied Sciences (NHL) in the Netherlands, and Linköping University (LiU) in Sweden along with four design led SMEs (Small to Medium Enterprises) and three National Design Agencies] aim to develop a training and exchange programme for Circular Design with an adoptable schedule conforming to the structures of these schools. The aim of the programme is to promote a culturally-diverse, interdisciplinary working environment for students from varying backgrounds (i.e. Product Design, Business, Materials Science). There are two main goals for this internship:

1. to develop an adaptable training programme with standardised educational tools and techniques, which can be integrated into many existing design departments around Europe. This, in turn, can build interdisciplinary capacity within those departments to train future designers with a comprehensive understanding of sustainability, as well as ways of undertaking innovative design practice to tackle its issues.
2. to create training opportunities for novice designers and other disciplinary students on working in multi-cultural training environments and tackling the issues of different local contexts and local industry, through setting up student exchange programmes and bringing industrial partners into the training programme.

3.1 ACTION RESEARCH AND DESIGN EDUCATION

This internship programme is being developed by four higher education institutions in four different EU countries, who share similarities on their approach to design education (i.e. practice-based learning in studio environment) and present differences in structuring of curriculum and content (e.g. duration of bachelor education, courses, trainings, access to workshops, etc.). This complicates the development of a standardised internship programme with respect to the students differing backgrounds and inclusion of the programme in existing curricula. On the other hand, the focus of the internship (i.e. sustainability and circular design) clarifies the common educational goals that help structure the internship programme. Hence, four higher education institutions agreed upon adopting an action research methodology through iterating the internship programme by reflecting on and building upon the previous implementation of it, and providing reflections and guidance for the subsequent internships.
Action research is a commonly used methodology in educational contexts for the continuous development of curricula and educational content, as the distinction between them (i.e. development and education) is removed, and they are brought together as research [21]. The educators' role changes significantly as well; they become researchers that perform continuous self-evaluation and work on the problems they identified [21]. The development and the goals of this internship programme are beyond the capabilities of a single researcher. The attempt to create a programme repeatable within different curricula and content, no less an exchange programme to bring together interns of different understandings on issues of sustainability and the development of the programme requires a collaborative framework.

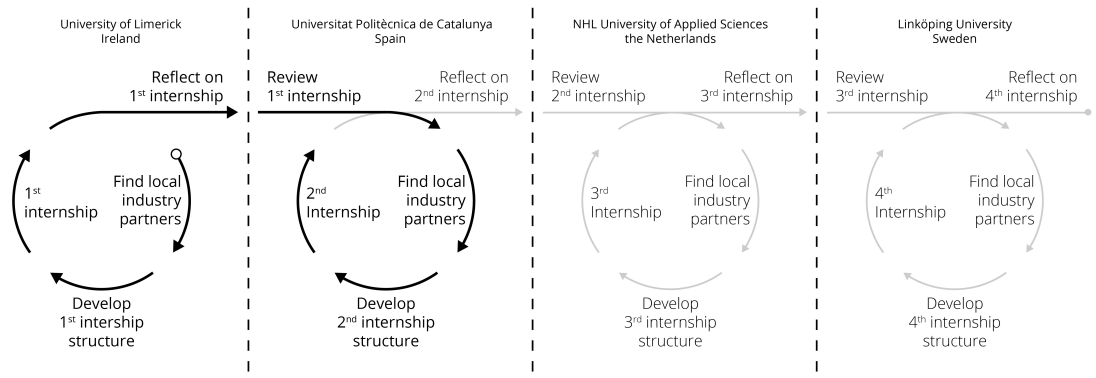

Figure 1: Collaborative Action Research Framework developed in the Circular Design (L4IDS) project, indicating the internship cycles.

In the case of education in general, collaborative action research brings together lecturers, human resources and researchers in an attempt to improve pedagogical practice and contribute to educational theory [22]. However, in this case of developing an adaptable Circular Design

internship programme, different institutions from different cultural backgrounds and pedagogical perspectives are involved and the development of the programme requires reflection of the involved researchers on the existing design education. Hence, in line with the action research cycle steps of reflection, planning and action [23], the collaborative action research framework in Figure 1 was developed. The first internship programme was planned in UL from September 1st to November 30th, 2017. Upon its completion, researchers will reflect on the internship and its outcomes, and this reflection along with all the internship material developed will be sent to the next institution (i.e. UPC, Spain). The educators/researchers in the second institution will review the materials, reflect on the first internship and further develop the internship structure and content. The outcome of this process will be a comprehensive internship programme to train the next generation of designers for a sustainable future, which can be conducted in different design schools all around Europe.

For this framework, the knowledge transfers among lecturers/researchers needed to be well-structured to ensure the continuation of the action research cycle thus reaching meaningful outcomes. The internship programme was developed according to key learning outcomes that were devised at the beginning of the first action research cycle:

-Creating the environment for interns to self-learn and experience the necessary tools and techniques for Circular Design.

-Facilitating learning for innovative, sustainable design for both the interns and the industry partners throughout the design process.

-Present the potential of innovative design tools and techniques for sustainability and circular economy as applied to real-life innovation processes.

To enable clarity for the interns and industry partners, and to let the interns experience an innovative design process from the beginning until the end, the internship programme is structured in four phases (i.e. Research, Ideation, Detailing and Prototyping). In the research phase, the interns gain the experience of collecting different kinds of input from various stakeholders and develop a focused design brief through understanding the context around their projects. In the ideation phase, they develop various design solution ideas to explore potential solutions and evaluate those ideas according to their design briefs. In the detailing phase, the interns develop their idea further to address all aspects of their design brief and finalize the design solution. In the prototyping phase, they build prototypes of their solutions and develop communication material to convey their solutions addressing the sustainability issues defined in their briefs to industry partners.

These phases also provide researchers with a structure to collect and analyse data throughout the design process. At the end of each phase, a group discussion with all interns is conducted to gather their insights and provide feedback to the next internship cycle. These group discussions revolve around their experiences throughout each phase, with regards to the design tools and methods they use, their communication with various stakeholders – including their industry partners –, masterclasses they take, and any other process they go through. These group discussions are voice recorded for analysis. The analysis is done according to the topics that emerge from these discussions.

3.2 INTERNSHIP RESULTS: FOCUS ON CIRCULAR PROCESS IN THE URBAN ENVIRONMENT

The internship programme was announced in the four partner universities, calling for students of varying backgrounds that were interested in issues of sustainability and wanted to experience design for sustainability in real-life contexts. The industry collaboration, interdisciplinary nature and multi-cultural approaches of the internship were clarified in this announcement. The applications were assessed according to academic and design performance, evidence of team work, interest in design for sustainability and demonstration of motivation to take part in this internship. As a result of this assessment, 48 interns from different backgrounds (i.e. Product Design, Business, Materials Science) were selected to participate.

Therefore, a total of 11 projects were performed by 48 interns and 16 industry partners. Addressing environmental problems this paper focuses on those 4/11 offering solutions to enhance the implementation of circular processes in the urban environment, described as follows:

- **Preventing Food Waste with Southern Regional Waste Management Office**, Limerick. Reimagining the food waste management in/around Limerick and develop solutions for prevention and reuse of food waste. This project identifies the issue of excessive amounts of food waste produced by citizens and the cultural implications of this issue. The project aims to intervene into existing models of discarding food waste and its waste stream to explore ways of preventing food waste in the first place.
- **Selective separation of waste in the workplace.** PC Recircula, a project that promotes the circular economy in the use, purchase and responsible management of resources and waste of Universitat Politècnica de Catalunya.
- **Material innovation for urban application. ZICLA,** a company that innovates with recycled products and with the management of residues.
- **Beestreet project with the Municipality of Leeuwarden.** BeeStreet is a popular shopping street of Leeuwarden in the north of the Netherlands. In this street new initiatives are being developed in relation to green energy, flora, water, and art. The project consisted in developing a solution in to help BeeStreet use **natural** resources such as rain water to benefit the street and surrounding infrastructure.

Although the challenges of each of the projects are quite diverse, they were regarded in the scope of the Circular Economy. These projects were well-aligned to observe the implications of Circular Design at different scales and how this internship programme can train the next generation of designers to respond to the diverse challenges imposed by a Circular Economy approach.

4. CONCLUSION

The Circular Design project builds on the experiences of the undergraduate and masters' level of learning around DfS and links it with SME needs in a CE environment. Many of the DfS programs that currently exist have a real challenge in implementing their learning within societal and industrial contexts. The multidisciplinary educational practice that use co-design methodologies alongside of CE strategic approaches are providing a link between stakeholders within the real economy. i.e. the SME sector and the students.

Much of the literature suggests why and how we could implement sustainable and circular design in industry; but practical examples exploring the realities of what this means and the

resultant compromises, confusion, conflict and complications, are limited. It is necessary to introduce novice designers in education to the complexities of sustainable design and circular design, and the challenges in introducing it in real-world contexts.

University is a great environment for this purpose as it provides the flexibility to build collaboration with industry and to enable novice designers to experience these challenges first hand. Through self-learning approach, interns learn how to access and critically reflect on the changing and advancing knowledge on sustainability and design, and then apply it to their work practice.

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TABLES AND FIGURES

Figure 1	Collaborative Action Research Framework developed in the Circular Design (L4IDS) project, indicating the internship cycles.

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